REMARKS

I. Status

No claims have been amended in this paper. There is no issue of new matter.

Upon entry of this paper, claims 85-88, 90, 93, 95-100, 104-116, 135-137, and 141-175 are pending and subject to examination.

II. Claim rejections - 35 U.S.C. § 112

In the Advisory Action, the Office maintains the rejection of claims 85-88, 90, 93, 95-100, 104-116, 135-137, and 141-175 under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. The Office also maintains the rejection of claims 85-88, 90, 93, 95-100, 104-116, 135-137, and 141-175 are rejected under 35 U.S.C. § 112, first paragraph, as allegedly failing to comply with the enablement requirement. *See* Advisory Action at page 2. Specifically, the Office contends that the Tgi is not a constant, and that the corresponding pages of the Polymer Handbook, supporting Tgi is a constant, "is not provided in the reply nor elsewhere in the record and was not considered." *Id.* Applicants respectfully disagree and traverse this rejection for the following reasons as well as for the reasons of record.

Applicants maintain that Tgi as used in the present claims is theoretical and is a constant for a given monomer. Applicants hereby submit copies of the corresponding pages of the Polymer Handbook showing that Tgi is a constant for each particular monomer. For example, the Tgi for acrylic acid is 379 K (which is approximately 105.84 °C (379 K - 273.16)). Applicants note that, as shown on the attached copy of page VI 197, there are more than 10,000 papers containing data regarding glass

transition temperature, the attached copies of the corresponding pages of Polymer Handbook only representing a fraction of those data.

As such, the claims are not indefinite as would have been recognized by one of ordinary skill in the art. Accordingly, Applicants respectfully request that the rejection be withdrawn.

CONCLUSION

In view of the foregoing remarks, Applicants respectfully request reconsideration of this application, and the timely allowance of the pending claims.

Please grant any extensions of time required to enter this response and charge any additional required fees to Deposit Account No. 06-0916.

Respectfully submitted,

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POLYMER HANDBOOK

FOURTH EDITION

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Glass Transition Temperatures of Polymers

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[illegible] mobility [illegible] and moderate fractions of high [illegible] molecules (long chains that have [illegible] than one crystallite) provide physical [illegible] increase T_g.

[illegible] families, such as the methacrylates and [illegible] show high dependencies of T_g on [illegible] bonding can affect T_g either by [illegible] energy of chain segments, or by [illegible] backbone degrees of freedom of chain [illegible] This last concept has been used (1240) to aid [illegible] models.

[illegible] increases, polymer T_g's may be little [illegible] may increase (51,52) (at least for isothermal [illegible] or may decrease (51,54). T_g values [illegible] are the highest quoted on the sample [illegible] of crystallinity, other factors being [illegible]

[illegible] the presence of crosslinks in a sample [illegible] relative to an uncrosslinked sample. This [illegible] independent of the chemical composition of [illegible] caused by the restricted motion of [illegible] near crosslinking sites. However, the [illegible] can behave similarly to a second [illegible] either an increase or a decrease in T_g [illegible] effect.

[illegible]

[illegible] published T_g data is caused by the [illegible] samples. Common impurities are unpolymer- [illegible] molecular weight polymer, solvents, [illegible] should be taken to remove such [illegible] presence in small concentrations can lead [illegible] in T_g of over 40°C and sometimes [illegible] transitions", for example "water [illegible] values are from publications that describe [illegible] taken to exclude diluents and the residual [illegible] diluents. Few references contain this [illegible] values should be regarded as only [illegible]

[illegible] Molecular Weight

[illegible] T_g of a homopolymer generally increases with [illegible] weight up to a limiting value, known [illegible] persistent T_g value (48,104,105). The [illegible] polymers with particular end-groups [illegible] crystallinity decreases with increasing [illegible] (107). For some polymers, T_g's are [illegible] molecular weight (108).

[illegible] on condensation polymers, are for [illegible] molecular weight and it seems likely [illegible] would be obtained if higher molecular [illegible] tested. Many polymers are not [illegible] with respect to molecular weight [illegible] molecular weight distributions. In [illegible] measure of molecular weight is a value, which itself can be very dependent on [illegible] olymer interactions and, to some extent on the temperature. Usually, the highest viscosities and the highest molecular weight polymers are associated with the most reliable data.

The classical model for the effect of molecular weight on T_g is (1219–1226)

$$T_g = T_g^{\infty} - \frac{A}{\bar{M}_n}$$

This model suggests that the glass transition temperature reaches a limiting value when the number average molecular weight of the polymer is large. Cowie and Toporowski (1220) have shown that there is no further increase in T_g when the molecular weight is above a critical value, which is similar to the critical molecular weight for viscosity.

5. Thermal History

We have previously discussed in detail how thermal history (cooling rate, annealing time, and temperature), as well as the method of T_g measurement affects the reported T_g.

6. Pressure

Increasing pressure increases T_g in a linear relationship. A simple model is (Refs. 1227–1230)

$$T_g(p) = T_g(0) + sp$$

where $T_g(p)$ is the glass transition temperature as a function of pressure, p is pressure, and s is the linear pressure coefficient. This coefficient is 0.2 K/MPa for flexible aliphatic chains, and 0.55 K/MPa for semirigid aromatic chains (1231–1233). The effect of pressure on T_g can be important in some processing applications, such as injection molding. A different method for modeling the effect of temperature takes into account pVT data near T_g (1235–1237), giving an equation that includes the bulk modulus of the polymer glass.

D. ESTIMATION METHODS FOR THE GLASS TRANSITION TEMPERATURE

Several researchers have developed group contribution methods for correlating polymer properties, including the glass transition temperature (1238–1240). These techniques emphasize quantitative modeling of the various effects of polymer structure on T_g, and are a valuable aid to interpreting experimental data and estimating glass transition temperatures for new materials.

E. CLASSIFICATION, NOMENCLATURE, AND ABBREVIATIONS

Over 10000 papers contain glass transition data (43). This section of *Polymer Handbook* represents a fraction of these

References page VI-253

data. Most of the data in the tables are for linear homopolymers. In general, the polymers contain no additives or diluents, and are thought to have low or no branching.

Polymers are subdivided into principle classes by the composition of their repeating chain segment: acyclic carbon polymers, carbocyclic polymers, acyclic heteroatom polymers, heterocyclic polymers, and copolymers. All entries are placed in the most senior class their structure commands (109,110) and appear in only one class. The subclasses and their entries are organized in alphabetical order.

1. Naming Conventions

With the exception of common polymers with accepted trivial names, the polymers are named substantially according to the ACS recommendations for polymer nomenclature (110) in conjunction with IUPAC rules (109); less common polymers are cross-referenced from the trivial to the systematic name. Systematic names are not given for all the polymers in order to save space. Substitutive nomenclature is generally used for simple radicals, but for long combinations of radicals replacement nomenclature has been used to provide a much shorter name (as for some fluorocrylates with ether side chains).

When sequences of radicals have repeated, the repeating sequence has been written once and prefixed "di", "tri", etc. as appropriate, for example, di(oxyethylene) for the sequence $-O-CH_2-CH_2-O-CH_2-CH_2-$. Note that the diradical "di(oxyethylene)" must be distinguished from the diradical "dioxyethylene" which has the structure, $-O-O-CH_2-CH_2-$, and also the diradical "ethylenedioxy" which has the structure, $-O-CH_2-CH_2-O-$ (IUPAC rule C205.2). The principle underlying the last-named diradical has not generally been extended to the naming of polymers in this section, *i.e.*, diradicals of structure $-X-Y-X-$ are not named YdiX, with the exception of alkanedioyl diradicals, because of the difficulty of locating indexed polymer names in which the diradicals are not named from left to right. Many polymers are derivatives of the diradical "propylene" $-CH(CH_3)-CH_2-$; the substituted diradical "propylene" is used in naming polymers inste[ad of] methylethylene" which could be preferred.

Polymer names are tabulated in alphabetical o[rder in] each subsection, but

1. prefixes like *sec-*, *tert-*, including desig[nations] and the numbers showing locations of sub[stituents] ignored except as secondary and tertiary in[dexing] order. For example, poly(ethylene 2,6-na[...] appears before poly(ethylene 1,4-terep[...] poly(4-*p*-anisoylstyrene) appears before p[oly(...ben]zoylstyrene).
2. multiplying prefixes for various substitue[nts,] dimethyl or trimethyl, are observed in al[phabetical] ordering rather than being grouped toge[ther ...] 3rd edition of this Handbook.
3. the locations of substituents in otherw[ise ...] polymers are taken as tertiary indicators o[f ...] numbers are arranged in increasing order a[t ...] point of difference. Thus, 2,3,8- comes be[fore ...]

Comments may include information as to the [...] measurement and, whenever possible, informat[ion ...]ing the method of DSC measurement (e.g. [...] conditions of measurement, thermal history, a[nd ...] measurements were made as a function of a [...] variable such as molecular weight (f(MW)).

2. Abbreviations

HR	Heating rate
CR	Cooling rate
0CR	Zero cooling rate
Xp	Extrapolate
TH	Thermal history
DSC	Differential scanning calori[metry]
TMA	Thermal mechanical analy[sis]
DTA	Differential thermal analysis
DMA	Dynamic mechanical analy[sis]
MW	Molecular weight
$f(\ )$	Function of a variable
Mdpt	Midpoint
Intg	Integration

F. TABLES OF GLASS TRANSITION TEMPERATURES OF POLYMERS

TABLE 1. MAIN-CHAIN ACYCLIC CARBON POLYMERS

Polymer	CAS No.	T_g (K)	Remarks
1.1. POLY(ACRYLICS) AND POLY(METHACRYLICS)			
1.1.1. POLY(ACRYLIC ACID) AND POLY(ACRYLIC ACID ESTERS)			
Poly(acrylic acid)	9003-01-4	379	
		348	
Poly(1-adamantyl acrylate)		426	
Poly(adamantyl crotonate)		507	
Poly(adamantyl sorbate)		388	
Poly(benzyl acrylate)		279	

TABLE 1. *cont'd*

Polymer	CAS No.	T_g (K)	Remarks	Refs.
Poly(2-ethylbutyl acrylate)		223	Brittle point	[illegible]
Poly(2-ethylhexyl acrylate)	9003-77-4	223	Brittle point	[illegible]
Poly(ferrocenylethyl acrylate)		430	No experimental details	[illegible]
Poly(ferrocenylmethyl acrylate)		470–483	DSC heating rate	[illegible]
Poly(3-fluoroalkyl α-fluoroacrylate)		398		[illegible]
Poly(4-fluoroalkyl α-fluoroacrylate)		368		[illegible]
Poly(5-fluoroalkyl α-fluoroacrylate)		374		[illegible]
Poly(8-fluoroalkyl α-fluoroacrylate)		338		[illegible]
Poly(17-fluoroalkyl α-fluoroacrylate)		388		[illegible]
Poly(fluoromethyl acrylate)		288	Estimated T_g	[illegible]
Poly(furfuryl acrylate)		321		[illegible]
Poly(1H, 1H-heptafluorobutyl acrylate)		243		155,8[illegible]
Poly(5,5,6,6,7,7,7-heptafluoro-3-oxaheptyl acrylate)		228		[illegible]
Poly(2,2,3,3,5,5,5-heptafluoro-4-oxapentyl acrylate)		218		830,[illegible]
Poly(heptafluoro-2-propyl acrylate)		278–283	No details on sample or measurement	[illegible]
Poly(heptyl acrylate)		213	Brittle point	821,[illegible]
Poly(2-heptyl acrylate)		235	Brittle point	[illegible]
Poly(hexadecyl acrylate)		308	Brittle point	23,821,[illegible]
Poly(1H,1H,3H-hexafluorobutyl acrylate)		251		[illegible]
Poly(hexyl acrylate)		216	Brittle point	[illegible]
Poly(3-hydroxyalkanoate)		293		[illegible]
Poly(isobornyl acrylate) conventional		367		[illegible]
syndiotactic		369		[illegible]
isotactic		363		
Poly(isobutyl acrylate)		249	Brittle point	[illegible]
		230		[illegible]
Poly(isopropyl acrylate) conventional		267–270		746,823,[illegible]
syndiotactic		271–284		[illegible]
isotactic		262		
Poly(magnesium acrylate)		673	Estimated from copolymer data	[illegible]
Poly(3-methoxybutyl acrylate)		217		[illegible]
Poly(2-methoxycarbonylphenyl acrylate)		319		[illegible]
Poly(3-methoxycarbonylphenyl acrylate)		311		[illegible]
Poly(4-methoxycarbonylphenyl acrylate)		340		[illegible]
Poly(2-methoxyethyl acrylate)		223		[illegible]
Poly(4-methoxyphenyl acrylate)		324		[illegible]
Poly(3-methoxypropyl acrylate)		198		[illegible]
Poly(methyl acrylate) conventional	9003-21-8	283		18,22,[illegible]
		284	Dilatomer	[illegible]
		290		[illegible]
		282		1401,[illegible]
head to tail		278		576,720,775-[illegible]
head to head		304		821,824,831,[illegible]
				845-[illegible]
Poly(2-methylbutyl acrylate)		241	Brittle point	823,[illegible]
Poly(3-methylbutyl acrylate)		228	Brittle point	[illegible]
Poly(2-methyl-7-ethyl-4-undecyl acrylate)		253	Brittle point	[illegible]
Poly(2-methylpentyl acrylate)		235	Brittle point	[illegible]
Poly(2-naphthyl acrylate)		358		[illegible]
Poly(neopentyl acrylate)		295		748,[illegible]
Poly(1H,1H-nonafluoro-4-oxahexyl acrylate)		224		[illegible]
Poly(1H,1H-nonafluoropentyl acrylate)		236		[illegible]
Poly(nonyl acrylate)		215	Brittle point	[illegible]
		184		[illegible]
Poly(octyl acrylate)	25266-13-1	208	Brittle point	821,841,[illegible]
Poly(2-octyl acrylate)		228	Brittle point	[illegible]
Poly(1H,1H,5H-octafluoropentyl acrylate)		238		[illegible]
Poly(pentabromobenzyl acrylate)		453		[illegible]
Poly(pentachlorophenyl acrylate)		420		[illegible]
Poly(1H,1H-pentadecafluorooctyl acrylate)		256	Crystalline	[illegible]
Poly(1H,1H-pentafluoropropyl acrylate)		247		[illegible]
Poly(n-pentyl acrylate)		216		[illegible]

[illegible]	CAS No.	T_g (K)	Remarks	Refs.
		331		1359
		330		1360
		344		1413
		359	with 25% wt. of chromaphore I-doped polymer	1418
		378	with 25% wt. of chromaphore II-doped polymer	1418
		348		1438
		347	DSC	1484
		285		824
		339		847
[illegible]ethyl methacrylate)		298		746
[illegible] methacrylate)		482	No experimental details	834
[illegible] methacrylate)		~458–468	DSC heating rate	835
[illegible] methacrylate)		355		1263
[illegible] methacrylate)		353		1263
[illegible] methacrylate)		350		1263
[illegible] methacrylate)		320		1263
[illegible] methacrylate)		310		1263
[illegible] methacrylate)		347		1269
		336		1360
[illegible] methacrylate) syndiotactic		~330		875
[illegible] methacrylate)		258	Mechanical method	876
[illegible] methacrylate)	25986-80-5	288	Brittle point, sample probably crystalline-may be T_m	821,866
[illegible] methacrylate)	25087-17-6	268		695,846, 858,877, 1251,1443
		273		1401
			DSC	1484
		270		1416
		274		1413
[illegible] methacrylate)	25249-16-5	328, 359	Conflicting data	746,878–880
[illegible]		311	DSC, dry Xp	1098
[illegible]		393	DSC, dry Xp	1199
[illegible] methacrylate)		349		846,878
[illegible] methacrylate)		358		1279
[illegible] methacrylate)		396/464/443		1401
[illegible] methacrylate)	64114-51-8	383		824
		423		1508
[illegible] methacrylate) random		326		746,821,824
[illegible]		281		846,881
[illegible] 20% isotactic		326		
[illegible] methacrylate)	9011-15-8	326		1401
		337		1438
[illegible] methacrylate) atactic		354		746,824,862
	26655-94-7	358		1401
isotactic		300		
syndiotactic		358		
[illegible]-D,L-glyceritol-1-*O*-yl [illegible])		335	Heating rate: 20 K/min	842
[illegible] methacrylate)		~763	Xp value	843
[illegible] acid)	54193-36-1	501	Xp data from plasticized samples	882
[illegible] anhydride) see Section 4.27				
[illegible] methacrylate)		379		746
[illegible])	9003-21-8	273		1255
[illegible] methacrylate)	9011-14-7			1102,1112,1101, 1107,1108
			DSC, onset, 16 deg/min HR, quenched, *f*(MW)	1101
			Dilatomer, CR 3 deg/h; creep relaxation, quenched	1109
		378		1432,1315, 1401,1288,1318